

REMARKS

By the present Amendment, claims 1-7 are cancelled and claims 8-20 are added. This leaves claims 8-20 pending in the application, with claim 8 being independent.

Substitute Specification

The specification is revised to eliminate grammatical and idiomatic errors in the originally presented specification. The number and nature of the changes made in the specification would render it difficult to consider the case and to arrange the papers for printing or copying. Thus, the substitute specification will facilitate processing of the application. The substitute specification includes no "new matter". Pursuant to M.P.E.P. § 608.01(q), voluntarily filed, substitute specifications under these circumstances should normally be accepted. A marked-up copy of the original specification is appended hereto.

Rejections Under 35 U.S.C. § 102

Claim 8 covers a method for producing a self-cleaning hydrophilic surface on an article, comprising the steps of supplying hydrophilic plastic material to a structure and shaping roll 20 having a first type of recesses 24 and a second type of recesses 22, and continuously producing first and second types of projections 12 and 16 on a common side of a base structure 10 facing away from the article. The projections are produced with the projections of a similar type being adjacent one another, with adjacent projections 12 of the first type contacting one another without spacing and with the second type of projections 16 on the projections of the first type, and are produced from the plastic material penetrating into the first and second types of recesses

which correspond to the first and second types of projections, respectively, as a foil or strip material.

Claim 1 stands rejected under 35 U.S.C. § 102((e) as being anticipated by U.S. Patent No. 6,488,570 to James. The James patent is cited as disclosing the claimed process including forming a surface having first and second projections, with the surface formed by a shaping/embossing roller (column 12, lines 63-68), and a hydrophilic plastic material (column 3, lines 6-9 and column 4, lines 39-67).

Claim 1 also stands rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,016,628 to Kolbach. The Kolbach patent is cited as disclosing the claimed process, including forming a surface having first and second projections (Figures 1 and 10) with the surface formed by a shaping/embossing roller (Figures 1-4), and an absorbent/hydrophilic plastic material (column 3, lines 6-9 and column 4, lines 39-67). The Kolbach absorbent fibers are alleged to be inherently hydrophilic.

Claim 8 is patentably distinguishable over the James and Kolbach patents, considered individually or in any proper combination thereof, by the use of a structure and shaping roll to continually produce the first and second types of projections, with the first projections contacting one another and the second projections being spaced from each other on top of the second projections. Such method is not anticipated or rendered by obvious by the James and/or Kolbach patents.

The James patent discloses a pad with a polishing surface 12. The polishing surface has deep flow channels 20 and shallow flow channels 18. The pad portions between the flow channels 20 are apparently interpreted as projections of the first type, while the pad portions between the

channels 18 are apparently interpreted as projections of the second type. However, if the pad portions between channels 20 are interpreted as being the first projections, such projections do not have the adjacent portions contacting one another without spacing as recited in claim 8. Rather, the channels 20 provide a spacing between such first projections. Additionally, the James patent does not disclose the forming of projections by a roll continuously. Instead, column 12, lines 63-68, which are cited relative to a roll, merely state:

"The mold can contain grooves or any other shaped designs, the pattern of which under the process of molding produces recesses in the article. The recesses may also be incorporated into the article after its formation by methods such as embossing or the like."

This generic description or disclosure of groove forming does not mention specifically or disclose inherently the use of a roll or a continuous production step as recited in claim 8.

Thus, the James patent does not anticipate or render obvious the subject matter of claim 8.

The Kolbach patent relates to a method and apparatus for forming absorbing articles, such as diapers. Thus, the Kolbach patent does not relate to a method for forming a self-cleaning surface on an article as recited in claim 8. Additionally, the Kolbach patent does not disclose a method of continuously producing the first and second types of projections as claimed, particularly with the second projections being on the first projections and with the second projections being spaced from one another. Relative to the projections, the embodiment of Fig. 10 is cited. Absorbent article 10 includes a medial portion 66 having a greater thickness than the flanking side portion 66 and the flanking end portion 70. The side and end portions are embossed with a pattern in the form of continuous compressed channels having a wavy line configuration with the channels being spaced from one another with relatively uncompressed high loft regions 74. The medial portion includes an embossed pattern of longitudinally extending channels 76 and transverse channels 78 and to

form a waffle-like pattern of compressed regions 80 defined between channels 76 and 78. In this manner, as illustrated in Fig. 10, the compressed regions 80 allegedly provide the larger first projections, while the loft portions 74 allegedly provide the smaller second projections. Under such interpretation, the second projections would not be on the first projections, as claimed.

If the entire medial region 66 is interpreted as a first projection, with the regions 80 being the second projections, then the James patent fails to recite a plurality of projections of the first type as claimed. Only one medial region 16 is provided. Moreover, the second projections 80 would not be spaced as recited in claim 8.


Thus, claim 8 is not anticipated or rendered obvious by the Kolbach patent.

Claims 9-20, being dependent upon claim 8, are also allowable for the above reasons. Moreover, these dependent claims recite additional features further distinguishing them over the cited patents.

Specifically, the formation of the roll recesses by sandblasting with materials of two different diameters of claim 9, the sandblasting with granules having further projections of claim 10, the specific materials of claims 11-13, the projection dimensions of claims 14-18, the cluster formations of claim 19, and the relative dimensions of the projections of the second type of claim 20 are not anticipated or rendered obvious by the cited patents, particularly within the overall claimed combination.

In view of the foregoing, claims 8-20 are allowable. Prompt and favorable action is solicited.

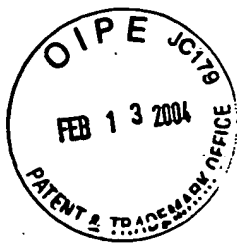
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43376

Marked-up
version

Patent Application

OF
AXEL SCHULTE
and
JAN TUMA
FOR

Method for the Production of Surfaces
Including Device for Execution of the Method
And the Surfaces and also Their Use

Structured

all
cups

Field of the Invention

^{ing}
present The invention relates to a method for the production of a surface for an
[having a base structure with two types of projections. Projections
of a similar type are arranged adjacent one another. The first type
object according to the features disclosed in the disclosure part of Patent
of projections contact one another without spacing. The second type of projections are arranged
on the projections of the first type.

^{present}
Claim 1. Furthermore, the invention relates to a device for execution of the

method as well as to the surface itself and its use.

FEB 24 2004

Background of the Invention

^{discloses}
~~From DE 35 24 653 C2, providing the~~ surfaces in the form of embossed,
^{ing}
biaxially laid out foils which form an apertured grid-like cloth as an article.
^{Its}
with openings and webs is already known, whereby ^{forming} elevated areas are
rounded off and deformed, each as a sort of projection, which leads to a web
component part incorporated within the cloth structure. The manufacture of
apertured netted cloths by embossment of a foil of thermoplastic polymers
using such a known solution leads to improved properties regarding its grip
and with corresponding subsequent treatment, leads to reduction of
undesirable shiny effects of the material.

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~~Furthermore, from EP 0 772 514 B1~~ ^{discloses} ~~are known~~ self-cleaning surfaces of articles which have a synthetic surface structure ^{having} ~~consisting of~~ projections and recesses ~~of a sort whereby~~ ^{The} spacing between the projections is in the range of 5 to 200 micrometers, ~~and~~ ^{The} height of the projections is in the range of 5 to 100 micrometers. ~~Then~~ ^{In} addition, at least the projecting parts are ~~to consist of~~ hydrophobic polymers or ^{other} ~~else~~ materials which are made permanently hydrophobic, ~~and~~ ^{not} ~~The~~ projections can be loosened and peeled off ~~neither~~ by water ~~or~~ by water with detergents added thereto.

The known solution shows a surface with these projections for ~~the~~ repelling ~~of~~ contaminants, whereby a simulated lotus-petal structure is synthetically constructed, ~~from which it is known that~~ ^{it} is not contaminated because of the capacity of the structure for self-cleaning, ~~and~~ ^{even} commercial adhesives are removable from the biological structure. Despite remarkable results with regard to a self-cleaning effect, such known surfaces can be used only in a limited manner, since either the range of materials which can be used in the production is greatly limited or the surface must be treated by

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further processing for the purpose of making it hydrophobic, which is costly.

Also, the known surface can be produced only at high cost while incurring considerable complications. For production of the known surface, coating

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methods or shaping methods are provided using high-grade mesh screens, which are costly and difficult to produce. Also in practice, it has been shown that such synthetically produced surfaces with 'lotus effect' often do not produce the desired results.

Finally, ~~from~~ PCT/WO 93/01047 ^{discloses} ~~is known~~ ^{having} a surface ~~consisting of~~ a deeply embossed, thermoplastic film. This film surface includes a plurality of macroscopic cells as first projections, which are connected by the areas extending between these adjacent macroscopic cells, ~~whereby~~ ^{The} macroscopic cells have a depth of 0.635 to 3.8 mm, ~~and in addition, to the~~ thermoplastic film incorporate ^a a plurality of microscopic indentations, which construct a fortuitously distributed sandblast pattern on the film, with a spacing between 1.25 and 7.35 micrometers. These microscopic indentations form a second type of projection, which projections have an opposite orientation to the projections of the first type, ~~so that~~ ^{The} the projections are arranged according to types separated from one another on opposite sides of the surface. Such known surfaces, usually in the form of polyolefin

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-3a-

foils, such as surfaces of polyethylene, are particularly used in those cases,
with projections of ^a raised area extending between them, ~~wherein~~ ⁱⁿ particular,
requirements are set on such cloth material relating to esthetic or visual

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sense-perceptions, in other words for use in the field of linings of clothing or ⁱⁿ ~~the~~ hygienic or sanitary areas, ^{Also, the surfaces} ~~and~~ have no dirt-repelling properties, so that a self-cleaning effect is not demonstrable in this case.

^{discloses}
~~From~~ EP 0 933 388 A2 ~~is known~~ a structured surface with hydrophobic and/or oil-resistant properties with low surface charges. The known surfaces have high boundary or rim angles with water and are cleaned with water only with difficulty and therefore include a self-cleaning effect. In order to attain this ^{structure surface,} a synthetically producible base structure is provided with two different types of projections, ~~whereby~~ ^{by} a type of smaller projections are mounted on a superstructure, in the form of projections of large dimensions, ~~which are mounted and are~~ in direct contact adjacent to one another. For the production of the known projections and the superstructure as an another type of projections, these projections either simultaneously or in sequence are mechanically impressed or embossed into the surface material, etched in by lithographic method or obtained by shaping processing by means of applied or casting technology. With the mechanical imprinting or embossing

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method, it is worked from the reverse side forward on the surface, which then on its opposite side shapes out the aforementioned two types of projections.

With etching of the structure into the surface material, the damage resulting from the etching medium is to be calculated at least in part. With the surface

shaping method, first of all the relevant projection structure is applied on the surface by means of an application roll applied to the surface material. The

last method is expensive and cost-intensive and does not guarantee that,

dependent upon the stress, the structure mounted thereon in this manner ^{does} not

~~again~~ become detached from the base material. The known casting,

imprinting or embossing, etching and surface application methods are

therefore not suitable in large-scale measure to make available the

production of large quantities of structured surfaces.

Summary of the Invention

~~Starting from this state of the art the object of the invention is to further~~ ^{present are to provide}

^{an} ~~improve the known~~ method for the production of synthetic surfaces having

two different types of projections, so that they can be ^{made} ~~realized~~ at lower cost,

and reasonably large volumes of surfaces can be made available by use of

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~~§~~ The foregoing objects are basically obtained by a

PROPOSED CLAIMS

8. ~~A~~ method for producing a self-cleaning hydrophilic surface on an article,

comprising the steps of X

supplying hydrophilic plastic material to a structure and shaping roll having a first type of

recesses and a second type of recesses, and

continuously producing first and second types of projections on a common side of a base

structure facing away from the article, ^{The projections are produced} with the projections of a similar type being adjacent one

another, with adjacent projections of the first type contacting one another without spacing and

with the second type of projections on the projections of the first type, ^{and are produced} from the plastic material

penetrating into the first and second types of recesses which correspond to the first and second

types of projections, respectively, as a foil or strip material.

insert
(A)
for p. 4b

-4b-

finishing techniques, ^{with} ~~and still~~ the surface particularly ^{having} ~~inheres~~ a very good repelling capacity for contaminants. ~~Such an object discloses a method for the production of such surfaces having the features disclosed in Claim 1 as well as a device for execution of the method with the features disclosed in~~ ~~Claim 2.~~ ^{present to provide a} Another object of the invention is the surface produced according to the method and the device, as well as its use.

(A) →

~~Due to the fact that according to the characterizing part of Claim 1 the surface is produced continuously by means of a structure and shaping roll as foil or strip material, which is provided with recesses corresponding to the first and second types of projections, into which the synthetically producible base structure enters for its shaping, a shaping method is realized in which the projections of the first and second type are depicted in reverse in the recesses of the structure roll and the surface is obtained in that manner.~~

^{of}
D With the ~~resulting~~ method, ^{of} shaping out by means of a structure and shaping roll having recesses to shape out the convex projections, the dirt-repelling surface can be made ~~available~~ uniformly and cost effectively in large quantities by use of manufacturing technology.

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-4c-

Preferably the structure and shaping roll ^{are} is configured so that, particularly with use of a backing roll, a shaping gap is formed, through which the synthetic material passes. Dependent upon the width and the diameter of the structure and shaping roll, the desired surfaces can be produced in any desired length and width, and insofar as the backing roll is configured as a shaping roll with a structure comparable to that of the structure and shaping roll, the desired microscopic surface structure can be produced on both sides. The synthetically producible base structure then penetrates into the surface of the structure and shaping roll for its shaping and then immediately leaves the structure and shaping roll as finished product. By the use of hydrophilic plastic material for the base structure, ~~therefore~~ ^{relative to} an improved dirt-repelling degree can be attained ~~than with~~ the known hydrophilic and/or oil-resistant structures.

~~In the case of the device according to the invention for execution of the method as in Claim 1, the recesses for the structure and shaping roll are~~ ^{can be} obtained by a sandblast method, ~~in which~~ ^{using} a stream of material of

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larger diameter and another stream of smaller diameter, the recesses for the first type ^{of projections} and the second type of projections are formed, ~~or in which~~ the stream of material ^{can be} is provided on its granular surface with further projections which form the recesses for the projections of the first type. The resulting sandblast methods are very cost effective and offer the required precision for the subsequent projection structures of the structured surface. The synthetic base structure ~~which is~~ obtained finds its equivalents in nature, for

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example, in the leaves of the nasturtium. Earlier research has shown that the nasturtium has an extremely fine ultrastructure regarding its leaves, with structural elements in the form of projections which are shorter than 12 micrometers. Such surface structures, which were not known in detail (cf. EP 0 772 514 B1, column 1, lines 4ff), were assumed to not be synthetically producible and considered in relation to their mechanical resistance capacity as extremely sensitive and consequently as unsuitable in terms of practical importance. On the other hand, it was seen in technical terms as simple to understand the lotus leaf structure as the natural pattern. It is consequently surprising for the expert in the art that on the one hand the extremely fine ultrastructure of the biological prototype of the nasturtium has succeeded as ascertainable, and on the other hand to complete the synthetic construction thereof and to develop ^{that} ~~said~~ construction further into a product which ~~on the one hand~~ has a very good dirt-repelling property and ~~on the other hand~~ unexpectedly ^{has} ~~also brings with it~~ the mechanical stability required for such a product.

The basic structure of the surface is indicated by a smooth lotus leaf

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structure, on which the projections are arranged protruding outward in such a manner that the basic structure is not flat, ~~but~~ rather, convex projections

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on the basic structure,
have been constructed thereon, on which in turn the smaller projections are
on the convex projections
mounted as integral component parts. Such structured surfaces are also
disclosed in
indicated in terms of the foils known from PCT/WO 93/01047 and DE 35 24
653 C2. Due to the fact that the first type of projections stands away each as
a convex curve from the base structure of the surface, then, as opposed to a
smooth structure, a considerably enlarged surface for the mounting of the
second type of projections is made available. Despite the doubts inherent in
technology, such surfaces according to the present invention can be constructed in
good form at low cost in large quantities of surface, whereby the thus
produced surface is mechanically stable, even under corresponding high
stresses applied to the surface or the base structure. Due to the fact that the
projections of the first type are arranged in contact with one another on the
case of the surface of the present invention in such a manner that the adjacent
projections of the first type engage on one another in close contact, and that
they also are cut down clearly smaller than the known orders of magnitude of the
dimensions in the case of the lotus leaf solution found in EP 0772 514 B1, if
the occasion arises then also an improved repelling behavior to repel

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-6a-

polluting particles is provided, since these features can be incorporated between the projections on the basic structure without further steps.

Preferably polyvinyl chloride, polyterephthalate, polymethyl methacrylate or polyamide are used as hydrophilic synthetic materials for the base structure.

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Due to the fact that, with one preferred embodiment of the surface according to the ^{present} invention, the second type of projections stands out gudgeon-like from the first type of projections, ~~and that~~ the relevant projection of the second type is in terms of height shorter than 5 micrometers or between 1.5 and micrometers, ~~and that~~ the spacing between the projections of the second type is likewise smaller than 5 micrometers, preferably 1 to 3 micrometers, ~~at~~ surface of microscopic structure ~~can be disclosed which if required~~ is suitable for use with adhesive closings, wherein hook elements of two closing parts cooperate with one another or hook elements of a closing part cooperate with loop material of another part.

The surface according to the ^{present} invention can be used particularly for articles in ~~order~~ to prevent their unwanted contamination, ~~and also, the aforementioned~~ projections of the first type are arranged in close contact adjacent to one another so that contamination particles of average dimensions impacting on

the surface cannot come in contact with the surface between the projections. Furthermore, the surface can be subjected to a current, for example an air or water current, so that in the main direction of the current, turbulence occurs because of the projections, ~~whereby Surprisingly, there occurs~~ a lowering of the wall friction ^{occurs}. Such surfaces having rib structures can be used for this purpose in the state of the art (cf. for example EP 0 846 617 A2).

(B) →

~~Hereinafter the surface is to be described in greater detail relative to one embodiment as shown in the drawing, which also shows more detail for its production and its use.~~

~~Shown in the drawing in principle but not in actual dimensions are the following :~~

- ~~Fig. 1 : a cross section of the surface in a side view;~~
- ~~Fig. 2 : a planar view of the surface arrangement as in Fig. 1;~~
- ~~Fig. 3 : a perspective view of the structure and shaping roll for production of the surface as in Figs. 1 and 2 with an enlarged section relating to its recessed structure.~~

(B)
for p. 9

Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses ^a preferred embodiment of the present invention.

Brief Description Of The Drawings

Referring to the drawings which form a part of this disclosure:

Figure 1 is a side elevational view in section of ~~a surface~~ ^{a surface} ~~an apparatus for~~ according to ~~a first embodiment of~~ the present invention;

Figure 2 is a ~~top~~ ^{surface} plan view ~~in section~~ of the apparatus taken along line A-A of Figure 1;

Figure 3 is a ^{perspective} ~~side elevational view in section~~ of ~~a structure and shaping roll~~ ^{a structure and shaping roll} ~~an apparatus~~

according to ~~a second embodiment of~~ the present invention ^{for producing the surfaces of Figures 1 and 2} and

Figure ^{3A} ~~4~~ is ~~a side elevational view in section~~ ^{an enlarged} ~~of the structure and shaping roll of Fig 3.~~ ^{view} ~~an apparatus for~~

~~according to a third embodiment of the present invention.~~

(C)
p. 13

While ~~various~~ ^{one} embodiment ^S have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

Structured Surface, Production and Use of Same

The invention relates to a surface for an object, the surface having a base structure which can be produced of synthetic resins and having both a first type of projections and a second type of projections, whereby the projections which are in turn of uniform type are arranged directly adjacent to one another.

From DE 35 24 653 C2, providing the surfaces in the form of embossed, biaxially laid out foils which form an apertured grid-like cloth as an article with openings and webs is already known, whereby elevated areas are rounded off and deformed each as a sort of projection, which leads to a web component part incorporated within the cloth structure. The manufacture of apertured netted cloths by embossment of a foil of thermoplastic polymers using such a known solution leads to improved properties regarding its grip and with corresponding subsequent treatment leads to reduction of undesirable shiny effects of the material.

Furthermore, from EP 0 772 514 B1 are known self-cleaning surfaces of articles which have a synthetic surface structure consisting of projections and recesses of a sort whereby the spacing between the projections is in the range of 5 to 200 micrometers and the height of the projections is in the range of 5 to 100 micrometers. Then in addition at least the projecting parts are to consist of hydrophobic polymers or else materials which are made permanently hydrophobic, and the projections can be loosened and peeled off neither by water nor by water with detergents added thereto.

The known solution shows a surface with these projections for the repelling of contaminants, whereby a simulated lotus-petal structure is synthetically constructed, from which it is known that it is not contaminated because of the capacity of the structure for self-cleaning, and even commercial adhesives are removable from the biological structure. Despite remarkable results with regard to a self-cleaning effect, such known surfaces can be used only in a limited manner, since either the range of materials which can be used in the production is greatly limited or the surface must be treated by further processing for the purpose of making it hydrophobic, which is costly. Also the known surface can be produced only at high cost while incurring considerable complications. For production of the known surface, coating

methods or shaping methods are provided using high-grade mesh screens, which are costly and difficult to produce. Also in practice it has been shown that such synthetically produced surfaces with 'lotus effect' often do not produce the desired results.

Finally, from PCT/WO 93/01047 is known a surface consisting of a deeply embossed, thermoplastic film. This film surface includes a plurality of macroscopic cells as first projections, which are connected by the areas extending between these adjacent macroscopic cells, whereby the macroscopic cells have a depth of 0.635 to 3.8 mm and in addition to the thermoplastic film incorporate a plurality of microscopic indentations, which construct a fortuitously distributed sandblast pattern on the film, with a spacing between 1.25 and 6.35 micrometers. These microscopic indentations form a second type of projection, which projections have an opposite orientation to the projections of the first type, so that the projections are arranged according to types separated from one another on opposite sides of the surface. Such known surfaces, usually in the form of polyolefin foils, such as surfaces of polyethylene, are particularly used in those cases, with projections of raised areas extending between them, wherein particular requirements are set on such cloth material relating to esthetic or visual

sense-perceptions, in other words for use in the field of linings of clothing or else hygienic or sanitary areas, and have no dirt-repelling properties, so that a self-cleaning effect is not demonstrable in this case.

Starting from this state of the art, the object of the invention is to further improve the known surfaces for an article by applying further provisions so that they can be realized at lower cost, and reasonably large volumes of surfaces can be made available by use of finishing techniques, and still the surface inheres particularly a very good repelling capacity for contaminants. Such an object is disclosed in a surface having the features found in Claim 1 and a method for the production of such a surface according to the features found in Claim 6. Furthermore another object of the invention is the use of the surface as disclosed in Claim 7.

Owing to the fact that according to the characterizing part of Claim 1 adjacent projections of the first type engage against one another in close contact, that the projections of the first and second types are arranged on one common side facing away from the article, and that the projections of the second type are mounted on the projections of the first type, a synthetically produced base structure is realized which would correspond in nature for

example in the leaves of the nasturtium. Earlier research has shown that the nasturtium has an extremely fine ultrastructure regarding its leaves, with structural elements in the form of projections which are shorter than 2 micrometers. Such surface structures, which were not known in detail (cf. EP 0 772 514 B1, column 1, lines 4ff), were assumed to not be synthetically producible and considered in relation to their mechanical resistance capacity as extremely sensitive and consequently as unsuitable in terms of practical importance. On the other hand it was seen in technical terms as simple to understand the lotus leaf structure as the natural pattern. It is consequently surprising for the expert in the art that on the one hand the extremely fine ultrastructure of the biological prototype of the nasturtium has succeeded as ascertainable and on the other hand to complete the synthetic construction thereof and to develop said construction further into a product which on the one hand has a very good dirt-repelling property and on the other hand unexpectedly also brings with it the mechanical stability required for such a product.

The basic structure of the surface is indicated by a smooth lotus leaf structure, on which the projections are arranged protruding outward in such a manner that the basic structure is not flat, but rather convex projections

have been constructed thereon, on which in turn the smaller projections are mounted as integral component parts. Such structured surfaces are also indicated in terms of the foils known from PCT/WO 93/01047 and DE 35 24 653 C2. Due to the fact that the first type of projections stands away each as a convex curve from the base structure of the surface, then, as opposed to a smooth structure, a considerably enlarged surface for the mounting of the second type of projections is made available. Despite the doubts inherent in technology, such surfaces according to the invention can be constructed in good form at low cost in large quantities of surface, whereby the thus produced surface is mechanically stable, even under corresponding high stresses applied to the surface or the base structure. Due to the fact that the projections of the first type are arranged in contact with one another in the case of the surface of the invention in such a manner that the adjacent projections of the first type engage on one another in close contact, and they also are cut down clearly smaller than the known orders of magnitude of the dimensions in the case of the lotus leaf solution found in EP 0 772 514 B1, if the occasion arises then also an improved repelling behavior to repel polluting particles is provided, since these features can be incorporated between the projections on the basic structure without further steps.

This provides the advantage that as opposed to the known solution according to EP 0 772 514 B1, one is not limited to hydrophobic polymer materials or materials which have been made permanently hydrophobic for use as surface material, but even hydrophilic plastic materials can be used, such as for example polyvinyl chloride, polyterephthalate, polymethyl methacrylate or polyamide, without thereby influencing the desired capacity for repelling of dirt.

Due to the fact that with one preferred embodiment of the surface according to the invention the second type of projections stands out gudgeon-like from the first type of projections and that the relevant projection of the second type is in terms of height shorter than 5 micrometers or between 1.5 and micrometers, and that the spacing between the projections of the second type is likewise smaller than 5 micrometers, preferably 1 to 3 micrometers, a surface of microscopic structure can be disclosed which if required is suitable for use with adhesive closings wherein hook elements of two closing parts cooperate with one another or hook elements of a closing part cooperate with loop material of another part.

In the case of the method according to the invention for the production of the aforementioned surface, this surface is produced continually by means of a shaping or structure roll as continuous foil or strip material, whereby the shaping or structure roll is provided with recesses corresponding to the first and the second types of projections, into which penetrates the synthetically producible base structure for its shaping and then the base structure leaves the shaping or structure roll as finished product. The aforementioned recesses on the shaping or structure roll can be realized preferably by means of a sandblasting method and for the formation of the structure the shaping or structure roll with another contacting or molding roll forms the mold gap for the passage of the strip of synthetic material which is to be provided with the base structure. Insofar as the counter-roll is configured as a molding roll with a comparable structure to that of the shaping or structure roll, the desired surface structure can also be generated on both sides of the surface structure.

The surface according to the invention can be used particularly for articles in order to prevent their unwanted contamination, and also the aforementioned projections of the first type are arranged in close contact adjacent to one another so that contamination particles of average dimensions impacting on

the surface cannot come in contact with the surface between the projections. Furthermore, the surface can be subjected to a current, for example an air or water current, so that in the main direction of the current, turbulence occurs because of the projections, whereby surprisingly there occurs a lowering of the wall friction. Such surfaces having rib structures can be used for this purpose in the state of the art (cf. for example EP 0 846 617 A2).

Hereinafter the surface according to the invention is to be described in greater detail relative to one embodiment as shown in the drawing, which also shows more detail for its production and its use.

Shown in the drawing in principle but not in actual dimensions are the following :

- Fig. 1 : a cross section of the surface in a side view;
- Fig. 2 : a planar view of the surface arrangement as in Fig. 1;
- Fig. 3 : a perspective view of the structure and shaping roll for production of the surface as in Figs.1 and 2 with an enlarged section relating to its recessed structure.

Detailed Description of the Invention

The surface shown in Figs. 1 and 2^{is} for an object ~~which is not to be~~ described in greater detail, ^{and} incorporates a synthetically produced base structure 10, wherein ^{base structure 10,} at some spacing ~~therefrom~~ a second type of projections 16 protrudes from the first type of projections¹² adjacent and engaging with one another in close contact, ~~whereby~~ ^{by} the second type of projections 16 are limited from the first type of projections 12 by areas 14, Fig. 2. The resulting first type of projections 12 is configured to be convexly elevated as compared with the basic structure 10, and, as shown in Fig. 1, forms closed off mounds in and of itself. From observation of Figs. 1 and 2, it is to be noted that ~~it has to do~~ ^{are} in the case of the ~~cited~~ projections with microscopic structures, and ~~accordingly~~ ^{illustrated} the representation greatly enlarges the effective conditions being represented ^{to} and ~~also~~ greatly simplifies the picture. Particularly, the spaces between the projections are shown only in principle, in order to clarify the sense of the invention. As Figs. 1 and 2 further show, projections 16 of the second type are arranged on the first type of projections 12, ~~and~~ ^{projections 16} consequently, on the side turned away from the article, ~~form integral~~ component parts of projections 12, with which they are integrally connected.

Basic structure 10 is formed of a synthetic material, preferably of a hydrophilic plastic material, such as polyvinyl chloride, polyterephthalate,

polymethyl methacrylate or polyamide. As Figs.1 and 2 further show, the second type of projections stand projecting gudgeon-like beyond the first type of projections 12, ~~whereby~~ ^Tthe relevant projection 16 of the second type is of a height shorter than 5 micrometers, preferably between 1.5 and 3 micrometers, ~~whereby~~ ^Tthe spacing between projections 16 of the second type likewise is smaller than 5 micrometers, preferably 1 to 3 micrometers. The respective height is measured from foot to apex point of each projection 16, ~~and the~~ ^Tspacing of projections 16 from one another is the average spacing between the exterior peripheries of projections 16. As can be seen particularly from Fig. 2, the relevant convexly configured projection 12 of the first type has a surface on the base structure 10 of between 20 and 300 micrometers², ~~and the~~ ^Theight between base structure 10 and the apex of the relevant projection 12 of the first type is between 10 and 50 micrometers. The limitable areas 14 form a sort of cluster structure ~~and said~~ ^Aareas 14 are in contact with one another essentially directly along connection lines 18.

A production method using a shaping or structure roll 20 is used for the production of the aforementioned surface, ^{and} ~~as~~ is shown in Fig. 3 in its principle construction. Using grooved roll 20, it is possible to continuously produce the surface out of synthetic material as foil or strip material.

whereby said shaping or structure roll 20 is provided with recesses 22 and 24 corresponding to the first and second types of projections 12, 16, into which the synthetically producible basic structure 10 penetrates in order to be shaped. In the direction of viewing seen in Fig. 3, ~~at the top left is shown an~~ enlarged section of the surface of shaping or structure roll 20, ~~which~~ shows the corresponding recesses 22, 24. Preferably, a sandblast method is used to produce the resulting recess structure for shaping or structure roll 20.

whereby with these sandblasting granules of enlarged diameter greater ~~form~~ concave recesses 24 ~~are formed, which thereafter serve~~ ⁱⁿ for the production of the first type of projections 12, and with a blast material of smaller diameter ~~then~~ ^{shape} within recesses 24 ~~the other recesses 22 can be shaped, which thereafter~~ ⁱⁿ serve for the production of the second projections 16. Instead of blasting material with various dimensions, it is also possible to use also only blasting material which on its granular surface is provided with further projecting components, which ^{further projecting components} form the recesses 22 for projections 16 of the second type. The resulting sandblasting methods are very cost effective and offer the required precision for the subsequent projection structures for the surface of the invention.

Shaping or structure roll 20 can be configured as a hollow cylinder and particularly can be heated, insofar as the plastic material to be treated makes this necessary. When another (not shown) support roll is incorporated, shaping or structure roll 20 then forms a profiling gap through which the plastic material passes. Dependent upon the width and diameter of shaping or structure roll 20, the desired surfaces can be produced in desired lengths and widths.

The surface thus produced can be used particularly ~~in order~~ to prevent the contamination of the covered articles, and projections 16 of the second type are arranged standing closely adjacent to one another, so that the free spaces between these projections 16 are smaller than the average dimensions of the contamination particles impinging on the surface.

The materials provided for the production of the surface for an article can be formed of regrowth-capable raw materials and are preferably biodegradable. The final regulation in this case is the DIN V 54900 ~~and~~ polyactides have been shown to be particularly suitable for the surface material.

Patent Claims

1. Surface for an article with a base structure (10) which can be produced of synthetic resins and having a first type of projections (10) and a second type of projections (16), whereby the projection of the in turn similar type are arranged adjacent to one another, characterized in that the adjacent projections of the first type (12) engage one another in close proximity without spacing, that the projections of the first and second type (12, 16) are arranged on a common side turned away from the article and that the projections of the second type (16) are mounted on the projections of the first type (12).
2. Surface as in Claim 1, characterized in that the base structure (10) is formed of a synthetic resin material, preferably of a hydrophilic plastic material, such as polyvinyl chloride, polyterephthalate, polymethyl methacrylate or polyamide.
3. Surface as in Claim 1 or 2, characterized in that from the first type (12) protrude gudgeon-like projections of the second type (16), that the relevant projection (16) of the second type is of a height shorter than 5 micrometers, preferably between 1.5 and 3 micrometers, and that the spacing between the projections (16)

of the second type is likewise smaller than 5 micrometers, preferably 1 to 3 micrometers.

4. Surface as in one of the Claims 1 to 3, characterized in that the projection (12) of the first type elevated convexly from the base structure has a surface on the base structure (10) between 20 and 300 micrometers² and the distance between the base structure (10) and the height of the apex of the relevant projection (12) of the first type is between 10 and 50 micrometers.
5. Surface as in one of the Claims 1 to 4, characterized in that limitable areas (14) formed of the projections (12) of the first type construct a cluster structure.
6. Method for the production of the surface according to one of the Claims 1 to 5, characterized in that this surface is produced continuously by means of a shaping or structure roll (20) as foil or strip material, which during the production is provided with recesses (22, 24) corresponding to the first and second types of projections (12, 16), into which penetrate the synthetically producible base structure (10) for its shaping.

7. Use of the surface as in one of the Claims 1 to 5 for articles in order to prevent their contamination, while the projections (16) of the second type stand in close proximity with one another, that the free spaces between these projections (16) are smaller than the average diameter of the contamination particle impinging on the surface.

Patent Claims

- 8
1. Method for the production of a surface for an article having a synthetic base structure (10) with a first type of projections (12) and a second type of projections (16), whereby the projections of similar type are arranged adjacent to one another, whereby the adjacent projections of the first type (12) contact one another with no spacing, whereby the projections of the first and second types (12, 16) are arranged on a common side turned away from the article and whereby the projections of the second type (16) are arranged on the projections of the first type (12), characterized in that the surface is produced continuously by means of a structure and shaping roll (20) as foil or strip material, which is provided with recesses (22, 24) corresponding to the first and second types of projections (12, 16), into which the synthetically producible base structure (10) penetrates for its shaping and that the base structure (10) is formed of a hydrophilic plastic material.
 2. Device for execution of the method as in Claim 1, characterized in that the recesses (22, 24) for the structure and shaping roll (20) are
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obtained by a sandblasting method, in which the recesses (24; 22) are formed with a blasting material of larger diameter and a blasting material of smaller diameter for the first type and second type of projections (12; 16), or in which the blasting material is provided on its granular surface with further projections, which form the recesses (22) for the projections (12).

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3. Surface produced according to the method as in Claim 1 as well as with a device as in Claim 2, characterized in that the hydrophilic

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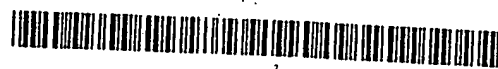
synthetic material of the base structure (10) is polyvinyl chloride, polyterephthalate, polymethyl methacrylate or polyamide.

- 14-17
4. Surface as in Claim 3, characterized in that projections of the second type (16) protrude gudgeon-like from the first type (12), that the relevant projection (16) of the second type is of a height shorter than 5 micrometers, preferably between 1.5 and 3 micrometers, and that the spacing between the projections (16) of the second type is likewise smaller than 5 micrometers, and preferably 1 to 3 micrometers.
- 18
5. Surface as in Claim 3 or 4, characterized in that the projection (12) of the first type rising convexly from the base structure has a surface on the base structure (10) of between 20 and 300 micrometers² and the height between base structure (10) and the peak height of the relevant projection (12) of the first type is between 10 and 50 micrometers.
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6. Surface as in one of the Claims 3 to 5, characterized in that limitable areas (14) formed of the projections (12) of the first type construct a cluster structure.

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7. Use of the surface as in one of the Claims 3 to 6 for articles in order to prevent their contamination, while the projections (16) of the second type stand in close proximity with one another, that the free spaces between these projections (16) are smaller than the average diameter of the contamination particle impinging on the surface.

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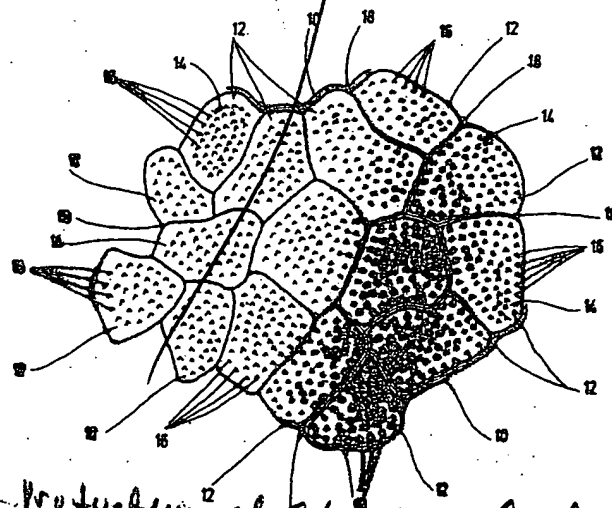
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Method for the Production of Structured Surfaces
Abstract of the Disclosure

(57) Abstract: The invention relates to a surface for an object, comprising a base structure (10) which can be synthetically produced, a first type of projection (12) and a second type of projection (16), whereby projections of each respective type lie adjacent to one another. The invention aims to provide a self-cleaning surface which is cost-effective to produce and has excellent dirt-resistant properties. To this end, the adjacent projections of the first type (12) are in close contact with one another, the projections of the first and second type (12, 16) are located on a common side, facing away from the object and the use thereof. The invention also relates to a method for producing said surface and to the use thereof.

This structured surface provides [Fortsetzung auf der nächsten Seite]

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